Address Problem (Theory C)

PROBLEM. Andy, Bob, Cindy, Dinah, Eve, Fred, and Gary live in the seven houses, numbered 1 through 7, on Maple Steet. Gary's address is 5 greater than Bob's. Bob's address is greater than Andy's. Dinah's address is less than Eve's, whose address is 2 less than Gary's. Cindy's address is less than either Dinah's or Fred's. Who lives where?

SOLUTION. One way to solve logic problems of this kind is by a process of elimination. Draw a matrix of addresses and people. Let the variables A, B, etc. stand for Andy's address, Bob's address, etc.

	1	2	3	4	5	6	7
A							
B							
C							
D							
E							
F							
G							

We proceed by marking the choices that are eliminated by the constraints expressed in the problem statement. The exposition that follows looks long, but bear in mind that all the steps are performed on a *single* matrix, which accumulates information as we go along.

1. *Gary's address is 5 greater than Bob's.* This clue can be written $G = B+5$. Since we also know that $G \leq 7$, it must be the case that $B \leq 2$, and $G \geq 6$. This is all the information we can infer from the first clue.

	1	2	3	4	5	6	7
A							
B			•	•	•	•	•
C							
D							
E							
F							
G	•	•	•	•	•		

2. *Bob's address is greater than Andy's,* that is, $B > A$. The only possibility is $A = 1$ and $B = 2$. So we can mark out all the other possibilities in the first two rows. Clue 1 says $B + 5 = G$, so $G = 7$. Once we know who has

a given address, we can mark out all the other possibilities in its column.

	1	2	3	4	5	6	7
A	√	•	•	•	•	•	•
B	•	√	•	•	•	•	•
C	•	•					•
D	•	•					•
E	•	•					•
F	•	•					•
G	•	•	•	•	•	•	√

3. *Dinah's address is less than Eve's, whose address is 2 less than Gary's.* This clue gives us two pieces of information, $D < E$ and $E + 2 = G$. Since $G = 7$, $E = G - 2 = 5$ leaving two possibilities for D, $D = 3$ or $D = 4$. We could guess and see what happens, but instead, let's see what information the last clue offers.

	1	2	3	4	5	6	7
A	√	•	•	•	•	•	•
B	•	√	•	•	•	•	•
C	•	•			•		•
D	•	•			•		•
E	•	•	•	•	√	•	•
F	•	•			•		•
G	•	•	•	•	•	•	√

4. *Cindy's address is less than either Dinah's or Fred's.* There are only three addresses left open. This clue says $C < D$ and $C < F$, that is, C is the smallest. So it must be that $C = 3$. Clue 3 says $D < E = 5$, and the only remaining address that satisfies that constraint is $D = 4$, which leaves $F = 5$ as the only choice of F.

	1	2	3	4	5	6	7
A	√	•	•	•	•	•	•
B	•	√	•	•	•	•	•
C	•	•	√	•	•	•	•
D	•	•	•	√	•	•	•
E	•	•	•	•	√	•	•
F	•	•	•	•	•	√	•
G	•	•	•	•	•	•	√

Now everybody has an address, but we should check our solution by verifying that all the clues are satisfied.

1. Is *Gary's address is 5 greater than Bob's?* Yes: $2 + B = 2 + 5 = 7 = B$.
2. Is *Bob's address is greater than Andy's?* Yes: $B = 2 > 1 = A$.

(c) Is *Dinah's address less than Eve's?* Yes: $D = 4 < 5 = E$.

(d) Is *Eve's address 2 less than Gary's?* Yes: $E = 5 = 7 - 2 = G - 2$.

(e) Is *Cindy's address less than either Dinah's or Fred's?* Yes: $C = 3 < 4 = D$ and $C = 3 < 5 = E$.